# XTune

## Video Processor, Scaler, Switcher, Integrated TV Tuner

Now has character text generator via rs-232

# Installation and Operations Manual

Manual Rev: 020901
Firmware Rev: 1.16 and above

**Aurora** *Multimedia*

# Table of Contents

## 1.0 <u>Product Description</u>

The XTune provides enhanced functionality to your display devices for a variety of applications.  Conference rooms,  video conferencing, training facilities, video production, home entertainment, and even office desktops will benefit from this small but powerful device.



Plasma Display          LCD Projector

## <u>Features</u>

- ➤ **Video Processor, Scaler, Switcher. Hi Res PiP, Integrated TV Tuner**
- ➤ **Multimedia Inputs: RF Input, Video/S-Video Input, Computer/Component Input.**
- ➤ **Compatible with 1080i, 720p, 480 i, 480p, VGA, SVGA, XGA input resolutions.**
- ➤ **Output Resolutions:  VGA, SVGA, XGA, 852x480, 1280x768, 1366x768, 480i, 480p, 576i, 576p, 720p, 1080i**
- ➤ **Hi-Res PiP capabilities such as Side-by-Side images, Transulcent PiP, Multi image PiP**
- ➤ **MAD$^{TM}$ (Motion Adaptive De-interlacing) provides superior image enhancements**
- ➤ **3:2 Pulldown**
- ➤ **Adaptive 4H comb filtering with Y/C processing produces exceptionally high quality images with image enhancement and noise suppression.**
- ➤ **RS-232, IR, Contact Closure Control.**
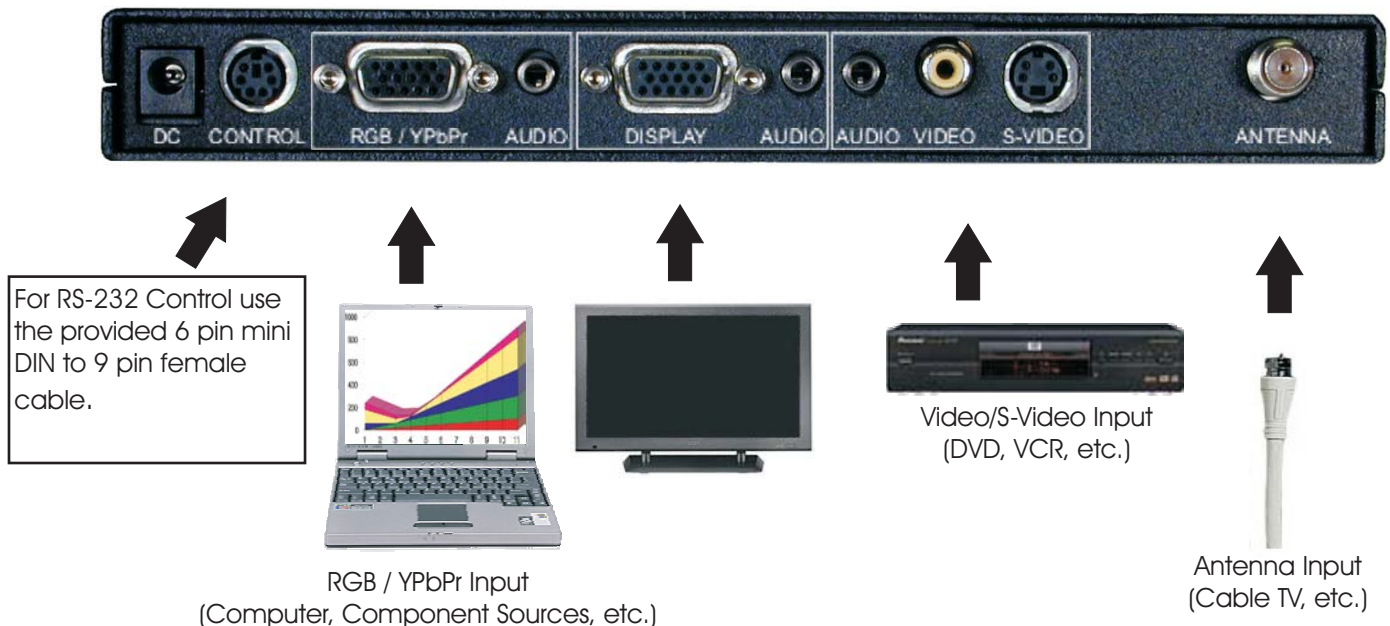- ➤ **Compact Size. Only 8.4"W x 5.65"D x 1"H**

**2.0  <u>Caution</u>:  Static (Still) pictures will cause "burn in" on certain types of displays and  may damage the display device.  Avoid prolonged usage of the PiP and On Screen Display.  When using static images, reducing brightness and/or contrast can help reduce the risk of damage to the display device.  Refer to the display's owners and technical manual about additional precautions.**

**3.0 <u>Unpacking</u>**

(1) - XTune
(1) - Installation and Operations Manual
(1) - 12 Volt (15 Watt) power supply
(1) - 47 Button Remote IRC-1
(1) - 6 Pin Mini DIN Male - Female 9 Pin (Firmware Upgrade / RS-232 Control Cable)

Note: Please examine the XTune for any signs of shipping damage.

**4.0 <u>Installation</u>**



For RS-232 Control use the provided 6 pin mini DIN to 9 pin female cable.

Video/S-Video Input
(DVD, VCR, etc.)

RGB / YPbPr Input
(Computer, Component Sources, etc.)

Antenna Input
(Cable TV, etc.)

**<u>XTune Setup/Connection</u>**

## 5.0  System Overview

The vast amount of features in the XTune can seem overwhelming at first.  As you will see it is pretty easy to catch on once explained.

Using the 47 button full featured remote many of the functions can be accessed directly.  When the menu button is pressed, an On Screen Display (OSD) generated from the XTune will appear.  As a protection against burning the screen the XTune menu will close if not used for 20 seconds.  The menu structure and features are described in the OSD section of the manual.  The menu is the key to all the features inside the XTune.

When the unit is first powered on the first item to take care of is matching the output resolution and output format to the display device.  The XTune can output Component (YPbPr) or RGB at many different resolutions.  These can be changed from the Menu under Display Setup.  Once this is done the image will look its best.  For example, if the LCD projector has a native resolution of XGA (1024 x 768) then the XTune should be set to output XGA.  If you do not then the projector will have to scale as well making the image less than perfect.  Aurora has put in most of the standard resolutions.  Check in the specification section to make certain we have a resolution to match.  If not please contact Aurora technical support as we might be able to add an additional resolution if it is within the units capability.

The XTune has a Main channel and a PiP channel.  Any input on the unit can be sent to the Main as well as the PiP but with limitations to the combinations.  The XTune can only PiP the 15 pin RGBHV / YPbPr -vs- Video / S-Video / TV.  It is possible to watch PC and TV at the same time but video with TV will not work.  Audio can follow the Main input or the PiP input by using the F3 key on the remote.

Full control over the Main and PiP channel independently can make viewing more enjoyable.  Controls for brightness, contrast, saturation, sharpness, size, phase, position, blending, and much more are available via the menu.  It is beneficial to play with all the different features to see the effects for better or worse to find what works best for your viewing.  The XTune will automatically try to make the best image when first locked on to the source but this can be overridden for additional sharpness, or maybe some noise reduction.

PiP modes vary based on output resolution.  Some resolutions have a full set of PiP modes while others are limited do to the aspect ratio (4:3 vs 16:9) and resolution.  Check in the specifications section of the manual for the PiP mode vs resolution that are currently available.  Future firmware upgrades may add additional modes so keep an eye out for updates.

Another great feature of the XTune is the ability to upgrade the firmware for additional features or fixes.  Try to keep an eye out for the latest releases on www.auroramultimedia.com to take advantage of the new version.  The firmware is easily upload to the XTune with the Flash123 utility that is free on our web site.

Remember, people see things differently.  What looks good to one person may not to another.  The power of the XTune allows you to tailor the image to just about anyones liking.  Most important... ENJOY!!!

## 5.1  Understanding PiP modes

While the XTune is very powerful in the feature set, there are some hardware limitations based on output resolution and source input resolution.  The Main input can upscale and downscale any image.  The PiP can only downscale or send out equal resolution when outputting a progressive signal.  That is why in some combinations the PiP window will not go as large as other modes.  For example, if the output is set to XGA and there is video in the PiP window, the window can only go as high as 240p since the input resolution is a 480i and the output is a progressive signal.  The resulting window will be no larger than 1/3 the screen.  The code protects a user from these limitations and will alert a user on screen when certain configurations can not be done.

Side by Side mode has the toughest job since the PiP is forced to be at a specific size.  PiP swap is not available in this mode so it is easier to tell which side (Main or PiP) is better suited for the input vs the output.  Example: XGA output will only work if the RGB source is sent to the PiP side and the video is sent to the Main.  However, in 1080i output it is best to send RGB to the Main and Video to the PiP.   If a combination does not work in side by side, try the opposite input (Main vs PiP).

Overall, the PiP modes can be a very powerful tool if understood and implemented correctly.  Presentations will benefit in ways that could not be cost effectively done.  Video Conferencing with the power of side by side and translucent PiP will solve problems of years past trying to view hi-res computer with the far end.  The best application for this unit is the one you create!!!

## 6.0 Remote Control

### Using the Aurora IRC-1 47 Button Remote
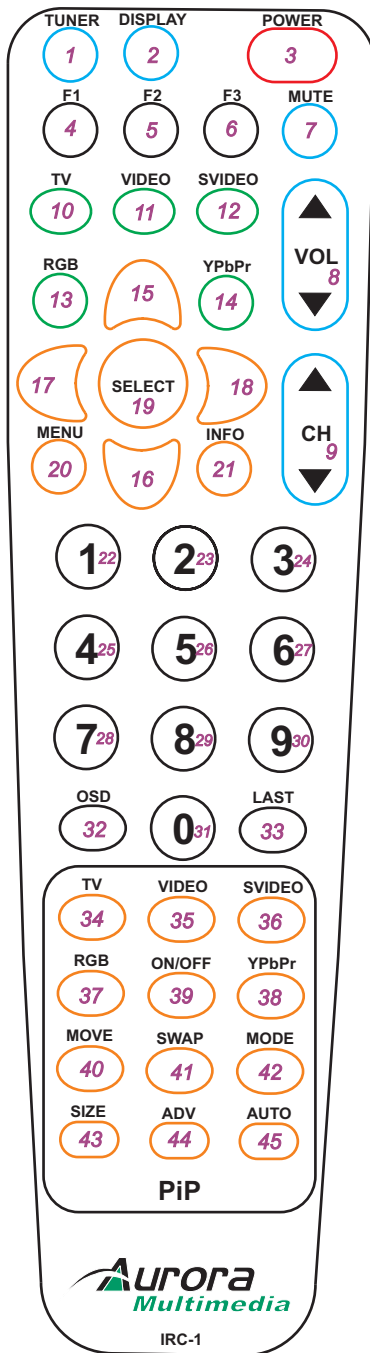
Make certain to press the TUNER button to change the control mode of the remote to XTune.

1. TUNER - Selects the XTune to be controlled from the remote
2. DISPLAY - Selects the Display Device
3. POWER - Turns on and off the XTune
4. F1 - Steps through the formats (Expand, Letter Box, Piller Box, etc)
5. F2 - Auto Adjust for RGB input
6. F3 - Audio follow (Main / PiP)
7. MUTE - Toggles the volume mute on/off
8. VOLUME - Ramps the volume up or down
9. CHANNEL - Changes the TV channel + or -

Main Input Selection
10. TV INPUT - Selects the TV Antenna as the Main input
11. VIDEO INPUT - Selects the Video as the Main input
12. SVIDEO INPUT - Selects the S-Video as the Main input
13. RGB INPUT - Selects the RGB as the Main input
14. YPBPR INPUT - Selects the YPbPr as the Main input

15. UP ARROW - Used with menu function to navigate and controls
                PiP Blending (Single PiP no menus on the screen)
16. DOWN ARROW - Used with menu function to navigate and
                controls PiP Blending (Single PiP no menus on
                the screen)
17. LEFT ARROW - Used with menu function to navigate
18. RIGHT ARROW - Used with menu function to navigate
19. SELECT - Used with menu function to select a feature
20. MENU - Enters and exits OSD menu structure
21. INFO - Displays in the upper corner input and timing information

22-31 Keys - Used for channel selection

32. OSD - Toggles On Screen Display on/off
33. LAST - Returns to the last channel select

PiP Input Selection
34. TV INPUT - Selects the TV Antenna as the PiP input
35. VIDEO INPUT - Selects the Video as the PiP input
36. SVIDEO INPUT - Selects the S-Video as the PiP input
37. RGB INPUT - Selects the RGB as the PiP input
38. YPBPR INPUT - Selects the YPbPr as the PiP input

39. ON/OFF - Turns Single PiP on and off
40. MOVE - Moves Single PiP to next area of display
41. SWAP - Main Input becomes PiP and vice-versa
42. MODE - Steps through all the PiP modes ex. single-pap-tile-etc
43. SIZE - Steps through different sizes PiP for Single Mode
44. ADV - Advances to next PiP window in the Tile modes
45. AUTO - Starts and stops 1 sec auto advance in the Tile Modes

**7.0 Front Panel**



The XTune front panel is simple but very effective.  The orange seven segment display shows the current TV channel selected for Main or PiP channel.

**Ch+**: Increments the TV channel up

**Ch-**: Decrements the TV channel down

**Vol+**: When no OSD menu is present it raises the volume.  If the menu is present it functions as the right arrow key.  Front LED display will show v 52 if the level is at 52 for example.  Times out after 3 sec.

**Vol-**: When no OSD menu is present it lowers the volume.  If the menu is present it functions as the left arrow key.  Front LED display will show v 52 if the level is at 52 for example.  Times out after 3 sec.

**Menu**: Toggles the OSD menu on and off

**Select**: Confirms a selection when pressed

**Power**: Toggles the XTune power on and off.  When turning on it takes about 2 seconds to initialize.  If the XTune loses power it will turn on when power is returned.

**Special Functions:**
**Select & Vol+ pressed together**: Changes the output resolution.  The LED will display r 01 - r 13 based on the resolution selected.

| | | | | | |
|---|---|---|---|---|---|
| r 01 | 720x480I | r 06 | 1280x720P | r 11 | 852x480P |
| r 02 | 720x480P | r 07 | 1920x1080I | r 12 | 1280 x 768 |
| r 03 | 720x576I | r 08 | VGA 60Hz | r 13 | 1366 x 768 |
| r 04 | 720x576I 100HZ | r 09 | SVGA 60HZ | | |
| r 05 | 720x576P | r 10 | XGA 60HZ | | |

**Select & Vol- pressed together**: Changes the output display format.  The LED will display d 01 for RGB and d 02 for YPbPr.
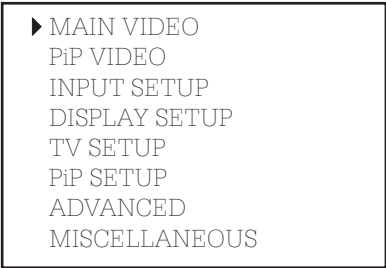
## 8.0 On Screen Display (OSD)

1. The On Screen Display is activated with the "Menu" button.
2. The OSD is removed if the "Menu" key is again pressed.
3. Pressing the "Menu key returns to the previous menu level. All menus initially mark the first menu item.
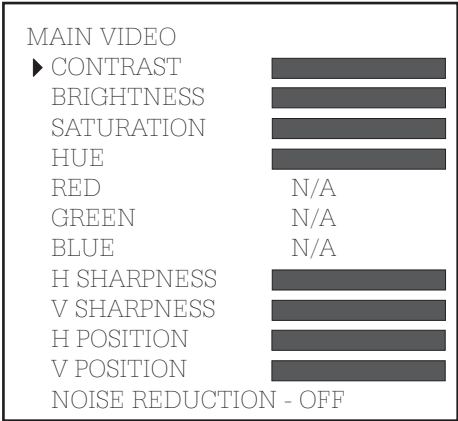
8.1 OSD MAIN MENU
The first menu column is a set of icons displayed vertically within the OSD.
Each menu item is used to navigate to a submenu, which is displayed when the "Select" key is pressed.

The MAIN startup menu contains the following menu items:

```
▶ MAIN VIDEO
  PiP VIDEO
  INPUT SETUP
  DISPLAY SETUP
  TV SETUP
  PiP SETUP
  ADVANCED
  MISCELLANEOUS
```

8.2 MAIN VIDEO
The MAIN video menu contains the following menu items for main channel adjustment. The slider is displayed on the right hand side of the sub menu items. The menu items are selected using "<" and ">" keys. The item is marked with "▶" when selected.

```
  MAIN VIDEO
▶ CONTRAST        ▭▭▭
  BRIGHTNESS      ▭▭▭
  SATURATION      ▭▭▭
  HUE             ▭▭▭
  RED        N/A
  GREEN      N/A
  BLUE       N/A
  H SHARPNESS     ▭▭▭
  V SHARPNESS     ▭▭▭
  H POSITION      ▭▭▭
  V POSITION      ▭▭▭
  NOISE REDUCTION - OFF
```

Pressing the "Select" key allows the value to be adjusted with the "<" and the ">" keys. The new value is saved when the "Menu" key is pressed (Text turns white).

```
  MAIN VIDEO
  CONTRAST        ▭▭▭
▶ BRIGHTNESS      ▭▭▭
  SATURATION      ▭▭▭
  HUE             ▭▭▭
  RED        N/A
  GREEN      N/A
  BLUE       N/A
  H SHARPNESS     ▭▭▭
  V SHARPNESS     ▭▭▭
  H POSITION      ▭▭▭
  V POSITION      ▭▭▭
  NOISE REDUCTION - OFF
```

8.2.1 CONTRAST
Activates slider to adjust picture contrast.

## On Screen Display (continued)

8.2.2 BRIGHTNESS
Activates slider to adjust picture brightness.

8.2.3 SATURATION
Activates slider to adjust color saturation.  (This item is disabled when input is RGB.)

8.2.4 HUE
Activates slider to adjust hue.  (This item is disabled when input is RGB.)

8.2.5 H SHARPNESS
Activates slider to adjust horizontal sharpness.

8.2.6 V SHARPNESS
Activates slider to adjust vertical sharpness

8.2.7 H POSITION
Activates slider to adjust horizontal input position.

8.2.8 V POSITION
Activates slider to adjust vertical input position.

8.2.9 NOISE REDUCTION
Enable or disable noise reduction filter in MAIN channel.
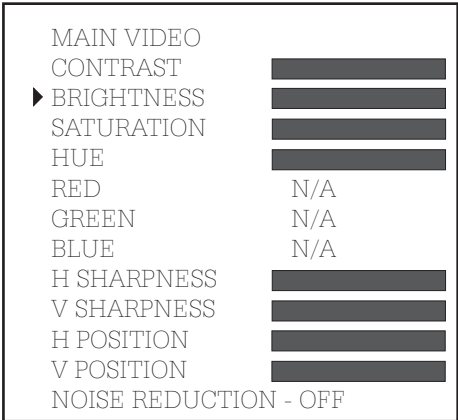
8.3 PiP VIDEO
The PiP video menu contains the following menu items for PiP channel adjustment. The slider is displayed on the right hand side of the sub menu items. The item is marked with "▶" when selected.  Pressing "Select" allows the value to be adjusted with "<" and ">" keys.

```
PiP VIDEO
   CONTRAST       ▭▭▭▭
   BRIGHTNESS     ▭▭▭▭
   SATURATION     ▭▭▭▭
   HUE            ▭▭▭▭
   RED          N/A
   GREEN        N/A
   BLUE         N/A
   SHARPNESS    N/A
   H POSITION     ▭▭▭▭
   V POSITION     ▭▭▭▭
```

8.3.1 CONTRAST
Activates slider to adjust picture contrast.

8.3.2 BRIGHTNESS
Activates slider to adjust picture brightness.

8.3.3 SATURATION
Activates slider to adjust color saturation. (This item is disabled when input is RGB).

8.3.4 HUE
Activates slider to adjust hue. (This item is disabled when input is RGB).

8.3.5 H POSITION
Activates  slider to adjust horizontal input position.

## On Screen Display  (continued)

8.3.6 V POSITION
Activates slider to adjust vertical position.


8.4 INPUT SETUP
The Input Setup menu contains the sub-menu for input signal selection and input format selection. Both MAIN and PiP channel can map to any one of the following video input.   However, there are restrictions based on the board configuration.  The chart below shows the valid input combinations.

| Valid Input Combinations | |
|---|---|
| MAIN | PiP |
| TV | RGB |
| TV | YPbPr |
| VIDEO | RGB |
| VIDEO | YPbPr |
| SVIDEO | RGB |
| SVIDEO | YPbPr |
| RGB | TV |
| RGB | VIDEO |
| RGB | SVIDEO |
| YPbPr | TV |
| YPbPr | VIDEO |
| YPbPr | SVIDEO |


8.4.1 MAIN INPUT
For MAIN channel signal source, pressing the "Select" key permits the change of input using the "<" and ">' keys. The color of the selection is RED when it is changed. Press "Select" key to confirm the current selection.

```
INPUT SETUP
 ▶MAIN INPUT        TV
   PiP INPUT         RGB
   MAIN FORMAT      AUTO
   PiP FORMATAUTO
   ADC CLOCK    [███████]   1350
   ADC PHASE    [█████]      10
   AUTO ADJUST
```

8.4.2 PiP INPUT
For PiP channel signal source, move "▶" down and press "Select" key then change of PiP input using the "<" and ">" keys.

```
INPUT SETUP
   MAIN INPUT        TV
 ▶PiP INPUT         RGB
   MAIN FORMAT      AUTO
   PiP FORMATAUTO
   ADC CLOCK    [███████]   1350
   ADC PHASE    [█████]      10
   AUTO ADJUST
```

## On Screen Display (continued)

8.4.3 MAIN FORMAT
Allows the user to manually override the auto input detection. The firmware detects the input format automatically and converts it to selected display format.

```
INPUT SETUP
   MAIN INPUT        TV
   PiP INPUT         RGB
 ▶ MAIN FORMAT       AUTO
   PiP FORMATAUTO
   ADC CLOCK     ▮▮▮▮▮▮▮      1350
   ADC PHASE     ▮▮▮▮         10
   AUTO ADJUST
```
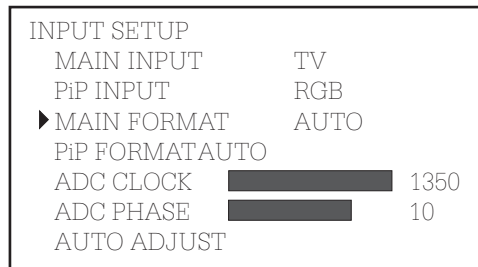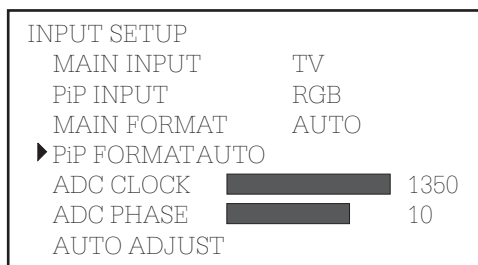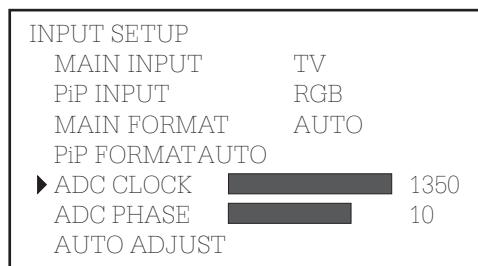
8.4.4 PiP FORMAT
Allows the user to manually override the auto input detection. The firmware detects the input format automatically and converts it to the selected display format.

```
INPUT SETUP
   MAIN INPUT        TV
   PiP INPUT         RGB
   MAIN FORMAT       AUTO
 ▶ PiP FORMATAUTO
   ADC CLOCK     ▮▮▮▮▮▮▮      1350
   ADC PHASE     ▮▮▮▮         10
   AUTO ADJUST
```
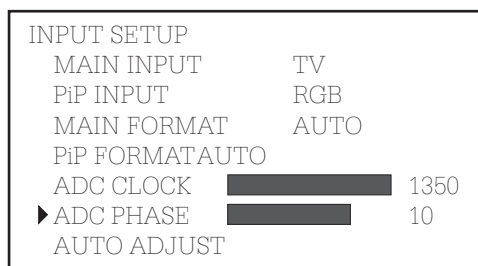
8.4.5 ADC CLOCK
Allows the user to manually override the default ADC clock for various RGB graphic modes. The firmware detects the input mode and programs the ADC clock accordingly. The menu item is disabled when the input is not RGB.

```
INPUT SETUP
   MAIN INPUT        TV
   PiP INPUT         RGB
   MAIN FORMAT       AUTO
   PiP FORMATAUTO
 ▶ ADC CLOCK     ▮▮▮▮▮▮▮      1350
   ADC PHASE     ▮▮▮▮         10
   AUTO ADJUST
```

8.4.6 ADC PHASE
Allows the user to manually override the default ADC phase for various RGB graphic modes. The firmware programs the ADC phase to zero for all input modes.  The menu item is disabled when the input is not RGB.

```
INPUT SETUP
   MAIN INPUT        TV
   PiP INPUT         RGB
   MAIN FORMAT       AUTO
   PiP FORMATAUTO
   ADC CLOCK     ▮▮▮▮▮▮▮      1350
 ▶ ADC PHASE     ▮▮▮▮         10
   AUTO ADJUST
```

8.4.6 AUTO ADJUST
Selecting this feature when RGB is selected and a source is present will try to lock the Clock, Phase, H. Position, and V. Position.  If the Auto feature can not figure the value it will exit without any effect.

# On Screen Display (continued)

8.5 DISPLAY SETUP
The display setup menu contains the sub-menu for output display timing and display format selection.

8.5.1 TIMING
Select from VGA, SVGA, XGA, 1366 x 768, 1280 x768, 852x480, 480i, 480p, 576p, 576i, 576i 100Hz, 720p, 1080i.

8.5.2 FORMAT
The output display format is can be set to 16:9 or 4:3 based on Timing setting.

```
DISPLAY SETUP
▶ TIMING          1920x1080i
  FORMAT          16:9 FULL
  H SCALE ADJUST  ▭▭▭
  V SCALE ADJUST  ▭▭▭
```

```
DISPLAY SETUP
  TIMING          1920x1080i
▶ FORMAT          16:9 FULL
  H SCALE ADJUST  ▭▭▭
  V SCALE ADJUST  ▭▭▭
```

8.5.3    H SCALE ADJUST
The user adjusts horizontal scale by "<" and ">" keys for the different types of plasmas and monitors. The horizontal display active start position is adjusted accordingly to keep the image in the center position.

8.5.4 V SCALE ADJUST
The user adjusts vertical scale by the "<" and ">" keys for different types of Plasmas and monitors. The vertical display active start position is adjusted accordingly to keep the image in the center position

```
DISPLAY SETUP
  TIMING          1920x1080i
  FORMAT          16:9 FULL
▶ H SCALE ADJUST  ▭▭▭
  V SCALE ADJUST  ▭▭▭
```

```
DISPLAY SETUP
  TIMING          1920x1080i
  FORMAT          16:9 FULL
  H SCALE ADJUST  ▭▭▭
▶ V SCALE ADJUST  ▭▭▭
```

8.6 TV CHANNEL
The TV channel menu displays the channel for each window (MAIN AND PiP) on the window list. This is an alternate method of changing channels without the requirement of selecting a window.

8.6.1 MAIN
The MAIN window channel number is always the first on the list. For MAIN, pressing the "Select" keys permits the changing of channels using the "<" and ">" keys or the numeric keys on remote control.  As of version 1.16 the ability to ADD and DELETE channels has been made available.  Pressing the select key again will move to the ADD/DEL field for that channel.  Use the arrow keys to toggle between the choices.  When using the channel + or - the DEL channels will be passed.

```
TV SETUP
▶ MAIN          CH 004 ADD
  PiP #01       CH 027
  TV SOURCE     BCST
```

```
TV SETUP
▶ MAIN          CH 004 DEL
  PiP #01       CH 027
  TV SOURCE     BCST
```

8.6.2 PiP
For PiP, pressing the "Select" key permits the change of PiP window number using the "<" and ">" keys.
The corresponding channel number is updated when PiP # is changed. Pressing the "Select" again permits the change of channels using the "<" and ">" keys or numeric keys on the remote control. The color of the number is RED when it is selected or changed.

```
TV SETUP
  MAIN          CH 004 ADD
▶ PiP #01       CH 027
  TV SOURCE     BCST
```

```
TV SETUP
  MAIN          CH 004 ADD
▶ PiP #04       CH 069
  TV SOURCE     BCST
```

## On Screen Display (continued)

8.6.3 SOURCE
There are three choices for TV sources: BCST (broadcast), CATV(cable), IRC and HRC.  The default setting is CATV.

```
TV SETUP
   MAIN          CH  004  ADD
   PiP #01       CH  027
   TV SOURCE     CATV
```
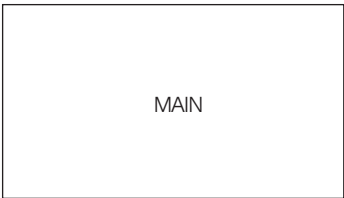
8.7 PiP SETUP
The PiP setup menu is used to subdivide the screen into a pre-defined set of windows. The actual formats are different depending on aspect ration of the output display.

```
PiP SETUP
 ▶ PiP MODE          -OFF
   ASPECT  RATIO
   SIZE          ▬▬▬▬▬
   H POS         ▬▬▬▬▬
   V POS         ▬▬▬▬▬
   PiP BLENDING  ▬▬▬▬▬
```

8.7.1 PiP MODE
The PiP mode selection is either OFF (default), ONE(single PiP), or TILE 1+4, TILE 1+12, TILE 0+16(multiple PiP), Side-by-Side images.  The values of the corresponding setup are not displayed when PiP mode is OFF.
The sub-menu items: aspect, ration, size, and position apply to single PiP mode only.

```
PiP SETUP
 ▶ PiP MODE          -OFF
   ASPECT  RATIO
   SIZE          ▬▬▬▬▬
   H POS         ▬▬▬▬▬
   V POS         ▬▬▬▬▬
   PiP BLENDING  ▬▬▬▬▬
```

```
          MAIN
```

Sub-menu items: ASPECT RATIO, SIZE, and POSITION apply only to single PiP mode.
i

```
PiP SETUP
 ▶ PiP MODE          - ONE
   ASPECT  RATIO
   SIZE          ▬▬▬▬▬
   H POS         ▬▬▬▬▬
   V POS         ▬▬▬▬▬
   PiP BLENDING  ▬▬▬▬▬
```

```
                      PiP
          MAIN
```
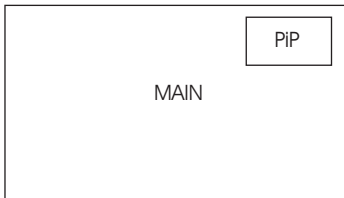
Sub menu item TILE mode apply only to multiple PiP modes.

```
PiP SETUP
 ▶ PiP MODE          - TILE
   ASPECT  RATIO
   SIZE          ▬▬▬▬▬
   H POS         ▬▬▬▬▬
   V POS         ▬▬▬▬▬
   PiP BLENDING  ▬▬▬▬▬
```

## On Screen Display (continued)

8.7.1.2 TILE MODE

The tile mode allows the user to see multiple PiP windows. The most common way to use tile mode is TV channel browsing. Each PiP window has a unique TV channel number (section 8.6.2 PiP) and the display is updated every second by moving the active PiP window sequentially. The TV tuner frequency is changed to the selected channel for each corresponding PiP window. Since the reference board has only one TV tuner, MAIN window can not watch TV in real time. The MAIN window can be setup for other video sources. Look at specifications section to see what modes are available for the output timing selected.

```
PiP SETUP
▶ PiP MODE        - TILE
  ASPECT  RATIO
  SIZE          ▭▭▭▭
  H POS         ▭▭▭▭
  V POS         ▭▭▭▭
  PiP BLENDING  ▭▭▭▭
```

| MAIN | PiP#1 |
|      | PiP#2 |
|      | PiP#3 |
|      | PiP#4 |

| PiP#1 | PiP#2 | PiP#3 | PiP#4 |
| PiP#5 | PiP#6 | PiP#7 | PiP#8 |
| PiP#9 | PiP#10 | PiP#11 | PiP#12 |
| PiP#13 | PiP#14 | PiP#15 | PiP#16 |

| PiP#1 | PiP#2 | PiP#3 | PiP#4 |
| PiP#5 |  MAIN | | PiP#6 |
| PiP#7 | | | PiP#8 |
| PiP#9 | PiP#10 | PiP#11 | PiP#12 |

8.7.1.3 SIDE BY SIDE MODE

The Side by Side mode allows the user to see two images, one MAIN and one PiP image together .

```
PiP SETUP
▶ PiP MODE        - SIDEBYSIDE
  ASPECT  RATIO
  SIZE          ▭▭▭▭
  H POS         ▭▭▭▭
  V POS         ▭▭▭▭
  PiP BLENDING  ▭▭▭▭
```

| MAIN | PiP |

8.7.2 ASPECT RATIO

There are two selections for aspect ratio, 4:3 and 16:9, available for display. The firmware calculates the PiP window size based on the selected aspect ratio and relative size value (1-10).

8.7.3 SIZE

The PiP window maintains its  aspect ratio regardless of size adjustments. The size can be adjusted in range 1 to 10 (the minimum to maximum PiP window size available). The PiP window size changes according to the output display resolution selected for MAIN window.

8.7.4 POSITION

The single PiP window has 9 (nine) pre-defined positions for selection.

        Top Left, Top Center, Top Right
        Middle Left, Middle Center, Middle Right
        Bottom Left, Bottom Center, Bottom Right

8.7.5 PiP BLENDING

PiP window blending level adjustment is available only when the single PiP window is displayed.

## On Screen Display (continued)

8.8 ADVANCED
Allows a user to manual override the Motion Adaptive De-interlacing and to turn on and off the directional processing.

```
┌─────────────────────────────────────────────┐
│  ADVANCED                                     │
│ ▶ MADI - VT                                   │
│   MADI threshold    ▐████████████▌            │
│   DI - on                                     │
└─────────────────────────────────────────────┘
```

8.9 MISCELLANEOUS

8.9.1 FILM MODE
The film detection switches between VT, AFM, GFX, and SM automatically.  This selection allows for manual selection of the processing modes.

8.9.2 OSD POSITION
Allows the user to move OSD to different position on the screen.   After the position is selected by "<" and ">" keys, the OSD can be further adjusted in both (V) vertical and (H) horizontal directions.  Values are incremented or decremented by the "<" and ">" keys.

## On Screen Display (continued)

8.9.4 SYSTEM INFO
Displays information that is related to the system.  The current installed firmware version is located here.
Updates to features and enhancements will be available on Aurora Multimedia's web site.

Please download Aurora FLASH 123 software to assist you in updating the firmware.

## 9.0 Specifications

### Supported Video Input Timing

| Input Format | Horiz. Freq. (KHz) | Vertical Freq. (Hz) | Active Resolution (Pixels x Lines @ Field/Frame Rate, Hz) | Total (Pixels x Lines) | Pixel Clock (MHz) |
|---|---|---|---|---|---|
| 525/60 NTSC, ITU-R BT601-5, RS-170M | 15.75/1.001 | 60.0/1.001 | 720x480 @ 59.94 i | 858x525 | 13.500 |
| 525/60 NTSC, CCIR 656 | 15.75/1.001 | 60.0/1.001 | 720x480 @ 59.94 p | 858x525 | 27.000 |
| 625/50 PAL/SECAM, ITU-R BT601-5 | 15.625 | 50.000 | 720x576 @ 50.00 i | 864x625 | 13.500 |
| 625/50 PAL/SECAM, CCIR 656 | 15.625 | 50.000 | 720x576 @ 50.00 i | 864x625 | 27.000 |
| 480p 4:3, SMPTE 293M | 31.5/1.001 | 60.0/1.001 | 720x483 @ 59.94 p | 858x525 | 27.000 |
| 720p, SMPTE 296M | 45.0/1.001 | 60.0/1.001 | 1280x720 @ 59.94 p | 1650x750 | 74.25/1.001 |
| 1080i, SMPTE 274M | 33.750/1.001 | 60.0/1.001 | 1920x1080 @ 59.94 i | 2200x1125 | 74.25/1.001 |

### Supported RGB PC Graphics Input Timing

| Mode | Resolution | Nominal Total | Horizontal Nominal Frequency +/-0.5kHz | Sync Polarity | Vertical Nominal Frequency +/-1Hz | Sync Polarity | Nominal Pixel Clock (Mhz) |
|---|---|---|---|---|---|---|---|
| VGA | 640x480 @ 60 Hz | 800x525 | 31.469 | N | 59.940 | N | 25.175 |
| VGA | 640x480 @ 72 Hz | 832x520 | 37.861 | N | 72.809 | N | |
| VGA | 640x480 @ 75 Hz | 840x500 | 37.500 | N | 75.000 | N | |
| VGA | 640x480 @ 85 Hz | 832x509 | 43.269 | N | 85.008 | N | |
| SVGA | 800x600 @ 56 Hz | 1024x625 | 35.156 | P | 56.250 | P | |
| SVGA | 800x600 @ 60 Hz | 1056x628 | 37.879 | P | 60.317 | P | 40.000 |
| SVGA | 800x600 @ 72 Hz | 1040x666 | 48.077 | P | 72.188 | P | |
| SVGA | 800x600 @ 75 Hz | 1056x625 | 46.875 | P | 75.000 | P | |
| SVGA | 800x600 @ 75 Hz | 1056x625 | 46.875 | N | 75.000 | N | |
| SVGA | 800x600 @ 85 Hz | 1048x631 | 53.674 | P | 85.061 | P | |
| XGA | 1024x768 @ 60 Hz | 1344x806 | 48.363 | N | 60.004 | N | 65.000 |
| XGA | 1024x768 @ 60 Hz | 1344x806 | 48.363 | P | 60.004 | P | 65.000 |
| XGA | 1024x768 @ 70 Hz | 1328x806 | 56.476 | N | 70.069 | N | |
| XGA | 1024x768 @ 70 Hz | 1328x806 | 56.476 | P | 70.069 | P | |
| XGA | 1024x768 @ 75 Hz | 1312x800 | 60.023 | N | 75.029 | N | |
| XGA | 1024x768 @ 75 Hz | 1312x800 | 60.023 | P | 75.029 | P | |

*Specifications subject to change without notice.*

## 9.0 Specifications (continued)

## Supported Output Timing

| Timing Format | Horiz. Freq. (KHz) | Vertical Freq. (Hz) | Active Resolution (Pixels x Lines @ Field/Frame Rate, Hz) | Total (Pixels x Lines) | Pixel Clock (MHz) |
|---|---|---|---|---|---|
| NTSC | 15.75/1.001 | 60.0/1.001 | 720x480 @ 59.94 i | 858x525 | 13.500 |
| NTSC line doubled | 31.500/1.001 | 60.0/1.001 | 720x480 @ 59.94 p | 858x525 | 27.000 |
| PAL | 31.250 | 100.0 | 720x576 @ 100 i | 864x625 | 27.000 |
| PAL line doubled | 31.25 | 50.000 | 720x576 @ 50.00 p | 864x625 | 27.000 |
| 720p | 45.0/1.001 | 60.0/1.001 | 1280x720 @ 59.94 p | 1650x750 | 74.25/1.001 |
| 1080i | 33.750/1.001 | 60.0/1.001 | 1920x1080 @ 59.94 i | 2200x1125 | 74.25/1.001 |
| VGA | 31.469 | 59.940 | 640x480 @ 60 Hz | 800x525 | 25.175 |
| SVGA | 37.879 | 60.317 | 800x600 @ 60 Hz | 1056x628 | 40.000 |
| XGA | 48.363 | 60.004 | 1024x768 @ 60 Hz | 1344x806 | 65.000 |
| 852x480 | 31.40 | 60.0 | 852x480 @ 60 Hz | 1000x525 | 31.500 |
| 1280x768 | 45.70 | 60.0 | 1280x768 @ 60 Hz | 1688x802 | 77.300 |
| 1366x768 | 48.363 | 60.0 | 1366x768 @ 60 Hz | 1600x806 | 77.300 |

## Supported PiP Modes vs Resolution

The current modes are as of version 1.15 firmware.

All resolution outputs support Single PiP, PAP, and Side by Side.

```
0 + 16 Tile PiP   - 720x576I 100HZ, 1920x1080I
1 + 12 Tile PiP   - 1920x1080I
1 + 7 Tile PiP    - 852x480P, 720x576I 100HZ, XGA 60HZ, 1280x720P, 1920x1080I
1 + 4 Tile PiP    - 720x576I 100HZ, 1920x1080I
1 + 3 Tile PiP    - 720x576I 100HZ
```

*Specifications subject to change without notice.*

## 10.0 Control Port

**RS232 -** Pins 1,3,5    Note: Pin 2 must be disabled with jumper J9 removed (factory default)
          Pin 1 - Ground        Pin 3 - TX       Pin 5 - RX

**Contact Closure -** Pins 1,2,4,6 *Note: Pin 2 must be enable with jumper J9 on XTune*
Pins 1,2:  PiP Swap          Pins 1,4: Channel +        Pins 1,6: Channel -        Pins 1,4,6: PiP On/Off
Pins 1,2,4,6:  PiP Move      Pins 1,2,4: Volumel +      Pins 1,2,6: Volume -

## 10.1 RS-232 Protocol

Baud Rate: 9600 8N1
*Note: Protocol below is as of firmware version 1.15  New commands will be available on future revisions to give more discrete full featured commands. Check on the Aurora website for the latest firmware and RS232 command additions.*

**? IS A QUERY COMMAND**          **(Does not have to be Case Sensitive)**
**! IS A COMMAND**               **(Does not have to be Case Sensitive)**
**~ IS A RESPONSE**              **(ALL RESPONSES ARE CAPITALS)**

*<CR> is 0D hex or 13 decimal*

| | |
|---|---|
| **!KEY_LEFT<CR>** | **Left** |
| **!KEY_RIGHT<CR>** | **Right** |
| **!KEY_CH-<CR>** | **Channel Down** |
| **!KEY_CH+<CR>** | **Channel Up** |
| **!KEY_SEL<CR>** | **Select** |
| **!KEY_MENU<CR>** | **Menu** |
| **!KEY_0<CR>** | **0** |
| **!KEY_1<CR>** | **1** |
| **!KEY_2<CR>** | **2** |
| **!KEY_3<CR>** | **3** |
| **!KEY_4<CR>** | **4** |
| **!KEY_5<CR>** | **5** |
| **!KEY_6<CR>** | **6** |
| **!KEY_7<CR>** | **7** |
| **!KEY_8<CR>** | **8** |
| **!KEY_9<CR>** | **9** |
| **!KEY_PAUTO<CR>** | **PiP Auto Start / Stop** |
| **!KEY_PSWAP<CR>** | **PiP Swap** |
| **!KEY_PMOVE<CR>** | **PiP Move** |
| **!KEY_PADV<CR>** | **PiP Advance** |
| **!KEY_PONOFF<CR>** | **PiP On/Off** |
| **!KEY_PSIZE<CR>** | **PiP Size** |
| **!KEY_VOL+<CR>** | **Volume up** |
| **!KEY_VOL-<CR>** | **Volume down** |
| **!KEY_MUTE<CR>** | **Volume mute** |
| **!KEY_RES<CR>** | **Display Resolution** |
| **!KEY_DFORM<CR>** | **Display Format** |
| **!KEY_PONOFF<CR>** | **PiP On / Off** |
| **!KEY_PMOVE<CR>** | **PiP Move** |
| **!KEY_PMODE<CR>** | **PiP Mode** |
| **!KEY_PWR<CR>** | **Power On / Off** |
| **!KEY_F1<CR>** | **Function 1 key used for Format selection (pillar box, letter box, etc)** |
| **!KEY_F2<CR>** | **Function 2 key (future use)** |
| **!KEY_F3<CR>** | **Function 3 key audio follow mode (Main or PiP)** |

| | |
|---|---|
| !KEY_UP<CR> | Up arrow key |
| !KEY_DOWN<CR> | Down arrow key |
| !KEY_OSD<CR> | On Screen display on/off button |
| !KEY_LAST<CR> | Toggles between the last 2 channels selected |
| !KEY_INFO<CR> | Shows information on the screen |
| !KEY_MTV<CR> | TV to Main |
| !KEY_MVID<CR> | Video to Main |
| !KEY_MSVID<CR> | SVideo to Main |
| !KEY_MRGB<CR> | RGB to Main |
| !KEY_MYPBPR<CR> | YPbPr to Main |
| !KEY_PTV<CR> | TV to PiP |
| !KEY_PVID<CR> | Video to PiP |
| !KEY_PSVID<CR> | Svideo to PiP |
| !KEY_PRGB<CR> | RGB to PiP |
| !KEY_PYPBPR<CR> | YPbPr to PiP |
| !FLBOX<CR> | Format Letter Box |
| !FPBOX<CR> | Format Pillar Box |
| !FPAN<CR> | Format Panoramic |
| !FAUTO<CR> | Format Auto |
| !AUDMAIN<CR> | Audio Follows Main |
| !AUDPiP<CR> | Audio Follows PiP |
| ?AUDIN<CR> | Query what the audio follows.  Responds with ~AUDMAIN<CR> or ~AUDPiP<CR> |
| !PWRON<CR> | Power On |
| !PWROFF<CR> | Power Off |
| ?PWR<CR> | Query Power status responds with ~PWRON<CR> or ~PWROFF<CR> |
| !VOLxx<CR> | Volume Level Set  xx=00 to 64  Responds with ~VOL52<cr> for volume  level 52. 00 is Mute for this command. 52 is zero dB |
| ?VOL<CR> | Query Volume Level Responds with ~VOL10<CR> for volume level 10. |
| ?MCH<CR> | Query Main Channel  Responds with ~MCH002<CR> for channel 2. |
| !MCHxxx<CR> | Main Channel change !MCH025<CR> for channel 25. xxx = 001 to 125 |
| !MSVIDPRGB<CR> | Main to SVideo, PiP to RGB |
| !MVIDPRGB<CR> | Main to Video, PiP to RGB |
| !MTVPRGB<CR> | Main to TV, PiP to RGB |
| !MSVIDPYPBPR<CR> | Main to SVideo, PiP to YPbPr |
| !MVIDPYPBPR<CR> | Main to Video, PiP to YPbPr |
| !MTVPYPBPR<CR> | Main to TV, PiP to YPbPr |
| !MRGBPSVID<CR> | Main to RGB, PiP to SVideo |
| !MRGBPVID<CR> | Main to RGB, PiP to Video |
| !MRGBPTV<CR> | Main to RGB, PiP to TV |
| !MYPBPRPSVID<CR> | Main to YPbPr, PiP to SVideo |
| !MYPBPRPVID<CR> | Main to YPbPr, PiP to Video |
| !MYPBPRPTV<CR> | Main to YPbPr, PiP to TV |
| !PONE<CR> | SIngle PiP |
| !POFF<CR> | Full Screen |
| !PSBS<CR> | Side by Side |
| !PPAP<CR> | PAP |
| !PT0+16<CR> | 16 Tile |
| !PT1+4<CR> | 1 Main 4 Tile |
| !PT1+7<CR> | 1 Main 7 Tile |
| !PT1+12<CR> | 1 Main 12 Tile |
| !PBxx<CR> | PiP Blending Level xx= 01 to 16  The higher the number the less transparent |
| !PSxx<CR> | PiP Size for Single Mode xx= 01 to 15  The higher the number the bigger the PiP |
| !PHxxxVxxx<CR> | PiP Position for SinIge Mode xxx = 000 to 100  Hxxx is Horizontal Position Vxxx is Vertical Position |
| !PxxCHxxx<CR> | PiP Channel Change Pxx is PiP number = 1 to 16  CHxxx is PiP channel = 001 to 125 |
| ?PxxCH<CR> | PiP Channel Query xx = 1 to 16 Responds with ~PxxCHxxx<CR> Pxx is PiP number CHxxx is PiP channel |

## 10.1 <u>RS-232 Protocol</u> (Continued)

| | |
|---|---|
| ?MIN\<CR\> | Main Input Query responds with ~MVID\<CR\> or ~MSVID\<CR\> or ~MTV\<CR\> or ~MRGB\<CR\> or ~MYPBPR\<CR\> |
| ?PIN\<CR\> | PiP Input Query responds with ~PVID\<CR\> or ~PSVID\<CR\> or ~PTV\<CR\> or ~PRGB\<CR\> or ~PYPBPR\<CR\> |
| ?PHV\<CR\> | PiP Single Mode Horz and Vert location Query responds with ~PHxxxVxxx\<CR\> xxx= 000 to 100 Hxxx is Horizontal Position Vxxx is Vertical Position |
| ?PMD\<CR\> | PiP Mode Query responds with ~POFF\<CR\> or ~PONE\<CR\> or ~PSBS\<CR\> or ~PPAP\<CR\> or ~PT1+4\<CR\> or ~PT1+12\<CR\> or ~PT0+16\<CR\> |

Use the commands below only if you are experienced with the operation of the XTune.  If they are not implemented properly, flashing of the video will occur if an invalid combination of Main and PiP are selected.  Try to use the dual switching commands above to prevent this scenario from happening.

| | |
|---|---|
| !MSVID\<CR\> | Main SVideo |
| !MRGB\<CR\> | Main RGB |
| !MTV\<CR\> | Main TV |
| !MYPBPR\<CR\> | Main YPbPr |
| !PSVID\<CR\> | PiP SVideo |
| !PVID\<CR\> | PiP Video |
| !PRG\<CR\> | PiP RGB |
| !PTV\<CR\> | PiP TV |
| !PYPBPR\<CR\> | PiP YPbPr |

## Character Generator Commands

The character generator is able to do 15 Rows by 30 columns and can be position anywhere on the display using the delay commands.

!CHDxxxVDxxx\<CR\>           Horizontal and Vertical Delay HDxxx = 000 to 255 VD = 001 to 255

This is the delay command. It determines where the 15 x 30 character display box will be located on the screen. Depending on the output resolution, the values may change from one resolution to the next to keep the text in the same area.  It is good practice to send the delay out at least once when powering up the unit since it is not stored in memory.

!CTxxFxSxxCxxHxxVxx-xxxxxxxxxxxxxxxxxxxxxx\<cr\>  Txx = 00 to 30 Fx = 0 or 1 Sxx = 16 to 63 Cxx = 0 to 7 Hxx = 0 to 29 Vxx = 0 to 14 -xxxxxxxxx = ASCII text up to 30 characters

This is the command that does it all.
T is text timeout which is up to 30 seconds.  00 is no timeout.
F is a function command. 0 does nothing but 1 will clear the entire OSD display
S is character size ranging from 16 to 63
C is color    0 - BLACK, 1 - BLUE, 2 - GREEN, 3 - CYAN, 4 - RED, 5 - MAGENTA, 6 - YELLOW, 7 - WHITE
H is Horizontal position (column) ranging from 0 to 29
V is Vertical position (row) ranging from 0 to 14
Anything after the - can be text up to 30 characters long. Be aware that if you start at H25 for example you can only enter 5 characters.  This is because you are starting 25 spaces over already leaving only 5 left.

The following string will clear the screen then send the text Hello World in the color Green on the 3 row starting at the 2nd column and timeout after 4 seconds with a text size of 20.
!CT04F1S20C02H01V02-Hello World\<cr\>
If it is desired to have multiple colors the next example will make Hello yellow and world blue.
!CT04F1S20C06H00V02-Hello\<cr\> then send !CT04F0S20C01H06V02-World\<cr\>

It is best if using the text generator to turn off the OSD.  If left on any command that utilizes the OSD will clear the last message sent.  It is recommended when using the command to use timeouts since static images can burn into

## 10.1 <u>RS-232 Protocol</u> (Continued)

**a display causing damage.**
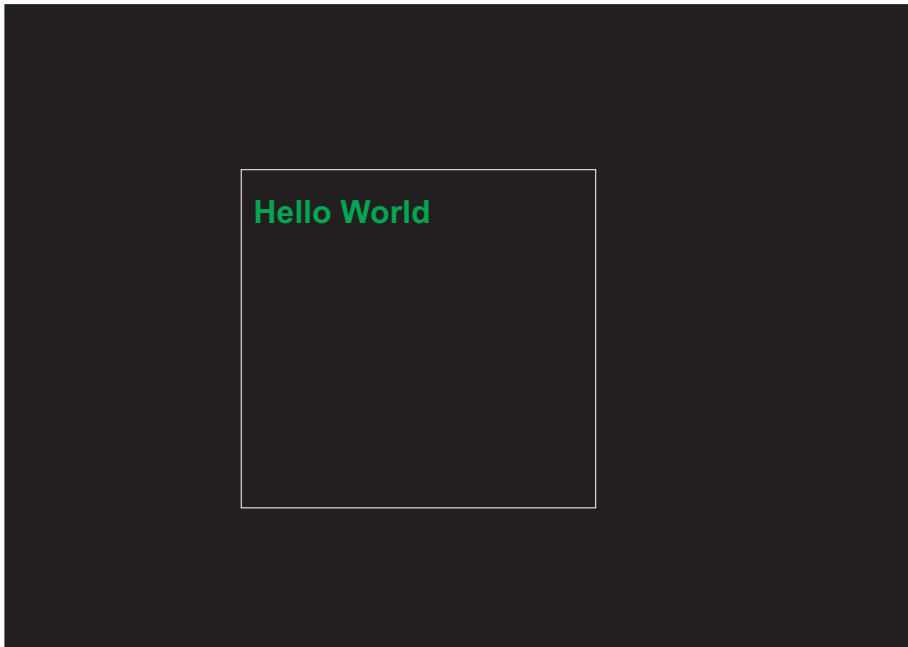


**The above is to show the display area (black) with the text Hello World in Green. The white outline is a representation of where the 15 x 30 area may be position based on the delay commands. A white border does not appear on the actual screen.**

## <u>General Info</u>

Unless otherwise noted all valid commands are echoed back if properly received.

When Main TV channel is changed via remote or contact closure, the RS232 is updated by sending a ~MCHxxx<CR> response

When Volume is changed via remote or contact closure, the RS232 is updated by sending a ~VOLxx<CR> response

Invalid commands will reply with ~ERROR<CR>.

## 11.0 <u>Connector Specifications</u>



## <u>DC</u>
2.1mm Power Connector (12 volts)
Center is Positive        Outer Shell is Ground

## <u>CONTROL</u>
**RS232 -** Pins 1,3,5     Note: Pin 2 must be disabled with jumper J9 removed (factory default)
     Pin 1 - Ground   Pin 3 - TX     Pin 5 - RX

**Contact Closure -** Pins 1,2,4,6 *Note: Pin 2 must be enable with jumper J9 on XTune*
Pins 1,2:  PiP Swap        Pins 1,4: Channel +        Pins 1,6: Channel -
Pins 1,4,6: PiP On/Off   Pins 1,2,4,6:  PiP Move
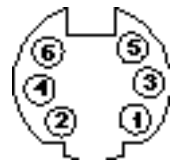


## <u>RGB/YPbPr and Display</u>

**15 Pin VESA VGA Connector**
1 Red video / Pr
2 Green video / Y
3 Blue video /Pb
4 Not used
5 Ground
6 Red (Pr) return (ground)
7 Green (Y) return (ground)
8 Blue (Pb) return (ground)
9 Key (no pin)
10 Sync return (ground)
11 Not used
12 Not used
13 Horizontal sync
14 Vertical sync
15 Not used



## <u>Audio</u>
**TRS Connector 1/8"**
Tip - Right     Ring - Left     Sleeve - Ground

## <u>S-Video</u>
**4 pin Mini Din**
1 Y Ground
2 C Ground
3 Y Intensity (Luminance)
4 C Color (Chrominance)

## 12.0 Troubleshooting

### *TV Tuner*

**Random noise in video image** - Check antenna position or cable connection. Weak signals can cause noise. Use of an RF Signal amplifier may help. Check the TV Source setting in the menu for proper selection between broadcast, cable, IRC, and HRC.

**White noise** - Check antenna position or cable connection. Check the TV Source setting in the menu for proper selection between broadcast, cable, IRC, and HRC.

**Hum on all channels** - Poor grounding will cause this problem. The cable feed should be grounded at entry into building or house structure. Jensen Transformers model VR-1FF CATV Ground Isolator may also do the trick if the ground problem can not be found.

**Ghosting** - Check antenna position. Sometimes to much gain from the cable source can cause this type of problem. Radio Shack sells 3dB and 6dB attenuators that might help.

### *Overall Image Quality*

**Image is always green** - Display output is set to YPbPr mode instead of RGB.

**Image does not fit screen** - Try adjusting the horizontal and vertical size in the XTune menu.

**Computer image jitters** - Try adjusting the clock and phase for the input or press F2 for Auto Adjust.

**Computer signal does not lock** - Make certain the output driver of the PC conforms to the input listing of the XTune. Try to use VESA standard modes as the XTune is programmed for most VESA standards up to 1024 x 768.

**Image flickers** - This can happen if 2 video sources are selected for the Main and PiP. (Example: S-Video is the Main and TV is the PiP.) This situation can only happen via RS232 control if the program allows the selection to occur.

### *RS-232*

**No Communication** - Make certain PC or control device is set to 9600 8N1.

**'ERROR' is always received** - Some terminal programs send both carriage return and line feed (0Dh, 0Ah) when the enter key is pressed. Make certain it only sends carriage return (0D hex). When writing code try to put a 0Dh 100ms before sending a XTune command to make certain the buffer is empty.

### *PiP Modes*

**Side by Side does not accept a source** - Depending on the output vs the input resolution the unit will not accept certain inputs in the Main or PiP. Just try reversing the selection.

### *On Screen Display*

**No OSD -** Pressing the OSD button on the remote will toggle the display on and off. The default on power up is on.

### 13.0 <u>Upgrading Firmware</u>

1) Download latest copy of Flash123 from www.auroramultimedia.com under the XTune product section.
2) Download the latest version of firmware.
3) Install Flash123 on a Windows 2000 or better machine.
4) With the power cord unplugged connect the 6 pin Mini Din to 9 pin RS232 cable between the Control port of the XTune and the Com port of the PC.  If you do not have a cable the help menu of Flash123 has the pin out.
5) Plug the power connector into the XTune and launch the Flash123 program.
6) Select the Com port, then the file, then click on start.  The firmware should start uploading.  This process could take a few minutes.  Do not turn off the power to the XTune or unplug the RS-232 cable when uploading firmware.
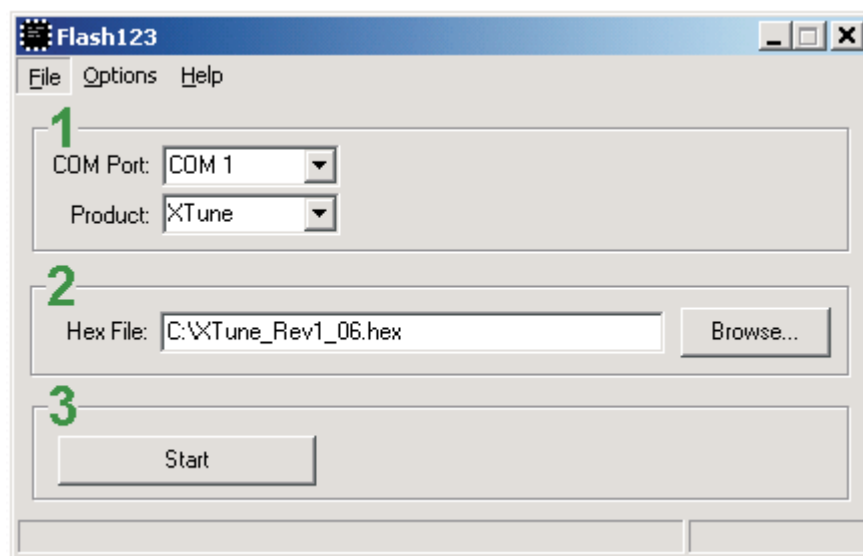


### <u>What to do if flash upgrade fails or is interrupted:</u>

Well everyone needs a backup plan just in case.
If a flash upload is interrupted, Flash123 will not work unless Hardware Boot is checked under the options selection. By selecting this, you are telling the Flash123 program it is still in firmware upgrade mode.  Once checked click on start again.



If there is difficulty in getting the XTune into boot mode there is a hole large enough for a paper clip in the front panel next to the menu button. With the power unplugged insert and hold the paper clip in while plugging the power in.  The LED should not be lit and there will be no output display.  Follow the above directions for hardware boot.

If Flash123 is restarted the default for Hardware Boot is unchecked.
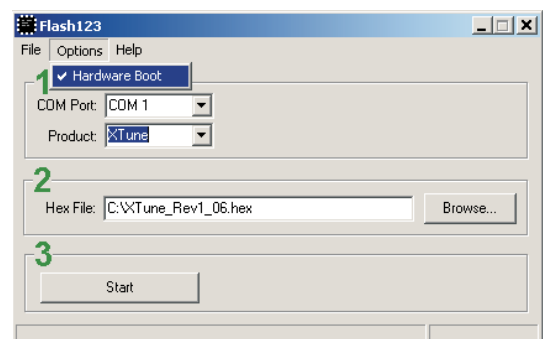
# Limited Warranty

**Aurora Multimedia Corp**. Warrants that this product is free of defects in both materials and workmanship for a period of 1 year for parts and labor from date of purchase. During the warranty period, and upon proof of purchase, the product will be repaired or replaced (with same or similar model) at our option without charge for parts or labor for the specified warranty period (1 year parts and labor).

This warranty shall not apply if any of the following:

    A) The product has been damaged by negligence, accident, lightning, water, act-of-God or mishandling; or,
    B) The product has not been operated in accordance with procedures specified in operating instructions: or,
    C) The product has been repaired and or altered by other than manufacturer; or,
    D) The product's original serial number has been modified or removed: or,
    E) External equipment other than supplied by manufacturer, in determination of manufacturer, shall have
        affected the performance, safety or reliability of the product.

In the event that the product needs repair or replacement during the specified warranty period, product should be shipped back to Manufacturer at Purchaser's expense. If requested, an estimate of any applicable charges will be given before the repairs are made.

**No other warranty, express or implied  other than Manufacturer's shall apply.**

    Manufacturer does not assume any responsibility for consequential damages, expenses or loss of revenue or property, inconvenience or interruption in operation experienced by the customer due to a malfunction in the purchased equipment. No warranty service performed on any product shall extend the applicable warranty period.

This warranty does not cover damage to the equipment during shipping and Manufacturer assumes no responsibility for such damage.

This product warranty extends to the original purchaser only and will be null and void upon any assignment or transfer.

# FCC Part 15 Statement

RADIO AND TELEVISION INTERFERENCE
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.  This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.  However, there is no guarantee that interference will not occur in a particular installation.  If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
    - Reorient or relocate the receiving antenna.
    - Increase the separation between the equipment and the receiver.
    - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
    - Consult the dealer or an experienced radio/TV technician for help.
You may also find helpful the following booklet, prepared by the FCC: "How to Identify and Resolve Radio-TV Interference Problems."  This booklet is available from the U.S. Government Printing Office, Washington D.C. 20402.
Changes and Modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commissions rules.
In order to maintain compliance with FCC regulations shielded cables must be used with this equipment.  Operation with non-approved equipment or unshielded cables is likely to result in interference to radio & television reception.